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Retrospect of Information Technology's Impact on Society and Warfare: Revolution or Dangerous Hype?

By

John J. White

Lieutenant Commander, United States Navy

Seminar#17

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

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ABSTRACT

What will be the actual potential of the concept of Network Centric Warfare (NCW) as the military progresses from theory to practice? The actual potential of NCW can be best understood by critical examination of the past, not imagination of the future. This analysis attempts to answer the degree in which the information age will affect warfare and what are the potential pitfalls. Is the concept of NCW the most significant Revolution in Military Affairs (RMA) since the Napoleonic Age? In order to answer the question, it is prudent to start at the origins of the idea, the information technology impact on the private sector and historical examples of innovations and warfare. The analysis continues with two key concepts that are at the nexus of NCW: shared battle space awareness and self-synchronization. The relationship between shared awareness and self-synchronization on the operational level of war is essential to the understanding of the true potential of NCW. Whether truly an RMA or not, the impact from information technology is dramatically changing current military operations. Examining the last American led immaculate war, the reality of the supposed RMA can be scrutinized apart from theory, war gaming, and exercises.

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INTRODUCTION

The advocacy of Network Centric Warfare (NCW) as the most important Revolution in Military Affairs (RMA) in the last 200 years, based on assumptions of the potential of the information age, may lead to wasted assets and a smaller, less capable force. This paper seeks to reveal NCW's actual potential and possible pitfalls from four related areas: private sector comparisons, the phenomena of innovation's impact on society, theories of network centric operations, and recent military events. This opinion differs from other NCW criticisms because it is based on events that have occurred after the surge of initial documents in the late 1990s advocating NCW as the RMA of the future. These events offer valuable lessons from the private and military sectors, and question the theory of network centric operations in business and warfare.

The same societal, business, and free market "revolutions" used to argue for the potential of NCW have imploded in the hype and exaggerated claims that the information age implies. The Internet, networks, and access to immediate information made great promises for economics, business, finance, and even warfare. Nevertheless, such exaggerated promises have led to a sobering reality in their respective fields. This disaster in the private sector from the hype of the information age should be heeded.

The unsubstantiated hype from technological innovation is not new, nor is the attempt to create shared battle space awareness through information superiority. Innovations in history have had similar effects on society and warfare. Information Technology (IT) is today's promise of innovation and an answer to the age-old pursuit of battle space awareness.

Similar to the private sector's "New Economy", the NCW concept relies on numerous layers of questionable assumptions in an attempt to be the RMA its advocates claim it to be. NCW proponents have used innovation hype to create a vision of warfare that shrinks the levels of war with a "flattened hierarchy" through effects-based targeting and self-synchronization with little discussion on operational art or the mission. NCW advocates insist that this new warfare can meet defense requirements in a more effective and efficient manner by networking sensors, shooters, and decision-makers.

Have proponents mistaken perfect target list execution through self-synchronization as the replacement for the art of war? NCW is attractive to the American way of war, which minimizes casualties through overwhelming combat power and technological superiority. The post Vietnam era United States desires immaculate wars fought from the air with cruise missiles, precision guided bombs, stealth technology, and no casualties. The false perception of NCW, which is being marketed by its advocates, will only increase the

desire for immaculate wars. *Operation Allied Force* (OAF) serves as an excellent example of the reality of how IT will be applied to warfare, and the resulting unintended, and sometimes perilous, results.

This analysis examines the potential disaster to U.S. military operations by attacking the same arguments that have been used to support the "systems of systems" concept. A critical examination of private sector experience and self–synchronization offers a muted vision of the transformation of military affairs. The technology of the information age and the necessity of using this technology in all areas of society in order to remain competitive are not disputed, nor is the benefit of speed of command from NCW. Nonetheless, the basic salesmanship of Network Centric concepts leads to a false conclusion of warfare efficiencies derived from technology, and raise numerous issues from recent military events.

Recent military events including *OAF* are far from the vindication of General Giulio Douchet's and Brigadier General Billy Mitchell's pioneering theories of air warfare. These early air power advocates claimed the innovation of the airplane would make other forms of warfare obsolete.[1] Moreover, Douchet and Mitchells's pioneering work demonstrates that the hype of innovation can lead to an exaggerated promise of a warfare panacea.

BUSINESS AND FREE MARKET'S NETWORK CENTRIC COMPARISON

Private sector comparisons of Network Centric processes have been used from the beginning by those NCW proponents who proclaimed the origins of the RMA. NCW advocates stated, "Across broad sectors of the economy, dominant competitors such as Dell Computer Corporation, Cisco Systems, Charles Schwab, Wal-Mart, and Amazon.com are successfully employing information-based strategies to create a competitive advantage in their respective domains."[2] The term NCW first appeared in a time of a technology mania, and was very much a product of that mania. NCW came to the forefront of warfare publications in the late nineteen nineties as information age mania and hype became rampant. The RMA was the main issue among an influential core of military leaders and defense analysts in the 1990s.[3] The above companies, used as role models for the transformation of the information age, were indeed believed to have a competitive advantage in 1999, at the published date of the statement. Society was being transformed by the Internet, cell phones, and all types of wireless devices. During this period, society was introduced to the terms of the "New Economy," dot.com companies, and the military was introduced to NCW. Advocates of NCW summarized the excitement of the global change-taking place:

"Even at this early stage of the Information Age, we are experiencing profound changes in the nature of our world. Wealth and power, for so long the providence [sic] of the few, are being created with new time constraints and distributed far more widely. For example, it is now possible for entrepreneurs behind

successful Internet-based companies (e.g., Yahoo, Amazon.com, and eBay) to become billionaires in periods measured in months, and for the public to share in this value-creation process."[4]

This optimistic statement was premature and demonstrates the unfounded hype that was being applied to these companies and the new RMA that the authors were advocating. This euphoria of the IT revolution came crashing down in hard reality. These billionaires lost their wealth in a matter of months, and the disaster was indeed shared by the public. By the end of 2000, over 370 publicly traded, IT companies lost more than 75% of their market capitalization and over a trillion dollars of value was lost.[5] Investment in IT's hype created an equity bubble that burst in magnitude that can only be compared to the great stock market crash of 1929. Cisco Systems, which had achieved the distinction of being the largest company in America by building the infrastructure for networks, would lose over 80% of its market capitalization value in a matter of months (fig.1). Amazon.com and Yahoo would lose 86% and 88%, respectively, of their value by 22 December 2000, a little over one year after they were used as the private-sector examples of the promise of the information age (fig.2/3).[6]

A similar fate would befall business-to-business (B2B) companies such as Commerce One and Ariba (fig.4/5). They were to revolutionize business by creating software and a network that enabled client companies to self-synchronize by creating shared awareness between distributors, suppliers, and customers. But the business revolution through self-synchronization and shared awareness was simply an exaggerated promise. Although these information-age changes in business may continue to evolve to increase productivity eventually, as they have in Wal-Mart, the revolution and hype of the New Economy has been crushed under the weight of basic business principles. Will NCW share a similar fate?

Some NCW critics argue that business and warfare are not comparable because warfare's essence is chaotic and irrational. War does not lend itself well to the comparison of stocking light bulbs at Wal-Mart with regard to rational human response. Actually, free markets are a more appropriate comparison to the irrational violence of warfare than the simple business model. Fundamental to free markets is the interaction between human beings and the information they utilize.

Examining how free markets, the stock market, are affected by information integration processes may reveal critical assumptions in the concept of NCW. If free markets were conducted by completely rational players with perfect information, then there would only be winners, and no "conflict" would ever take place.[7] "Of course, perfectly rational players don't exist, and perfect information is asymptotic in nature - it can be approached but never reached."[8] This statement is as relevant to NCW as it is to the description of the stock

market, the case in question. The heralded RMA concept relies on a perfect information process to create shared awareness utilized by perfectly rational players who will self-synchronize.

The surge in economic productivity from IT is itself being questioned. The "New Economy", a term coined from the information age revolution, has been likened to the second Industrial Revolution due to the profound impact on society, yet the evidence still does not reflect the revolution in results. The hype of the information age revolution consists of claims of sustained productivity growth and elimination of the normal business cycle.[9] However, factual evidence suggests otherwise. Productivity growth remained at 1.4% from 1973 to 1995, during the time of the mainframe computer, networks, and the Internet.[10] Furthermore, the recent spike in productivity from 1999-2000, which was attributed to networking, is more the product of revised calculations of productivity. The cost of IT is counted as an investment, not an expense. More importantly, the labor hours for the service industry and white-collar jobs are not accurately represented.[11]

Nobel Prize winner Robert M. Solow's investigation into the mismatch between IT investment and productivity, coined the term Productivity Paradox and stated, "We can see the computer age everywhere but in the productivity statistics."[12] This paradox of the expectations of productivity growth from the information age revolution is due to the amount of time required to develop practical applications of that technology. No single innovation can itself make significant advances in productivity, because by the time widespread application of that technology is established, there is no longer a paradox or a revolution.[13]

The validity of the private sector and warfare comparison can be considered on many levels of decision making. Yet, central to the analogy is the organizational effect of self-synchronization from shared awareness. The pioneers of NCW, such as Admiral Arthur Cebrowski, David Alperts, and John Garstka, may be forced to reconsider the comparison or acknowledge the less than stellar private sector results. Both achievements and calamities that the private sector has experienced in the revolution of the information age should be closely analyzed before significant investment in NCW continues, and is lost.

A realistic vision of NCW should be learned from the private sector before another large investment is lost. The potential danger is in building a force that delivers less than expected and therefore is unable to respond to all types of conflicts other than "immaculate wars." Moreover, a warfare concept that mistakes high-tech tactics and perfect targeting for operational art may lead to a disaster that parallels the "equity bubble", based on hype instead of tried and true principles.

IT and Network Centric organizational changes did not replace the basic principles of business or repeal the business cycle, nor will it revolutionize the way wars are fought. Self-synchronization through shared

awareness did not create wealth in the private sector by its own power, and will not be a warfare force multiplier of the magnitude its proponents predict. It is possible that IT has increased the productivity of the world's largest economy, yet there are limits to the productivity gains. Technology will bring its benefits to all levels of war, but should not replace the lessons learned from the history of warfare with unsubstantiated claims. Technological innovation in history has influenced significantly all levels of war, but not argued for the dissolution of basic warfare principles. The premise of NCW is vastly different because it does argue for such dissolution without evidence.

THE EFFECT OF INNOVATION ON SOCIETY AND WARFARE

The phenomenon of the information age and NCW is history repeating itself and reveals potential pitfalls for NCW. Throughout the history of technological advances, there have been similar effects in society, business, and warfare. Innovations can be simple accidents in origin and others born from technology and imagination can stir unrealistic expectations.[14] Additionally, the attempt to achieve shared battle space awareness is not new and has troubling historical examples. Moreover, the development of sound doctrine for the application of the technology may be as important as the invention itself.

Railroads and the telegraph had major effects on both the private sector and warfare. Their legacy may reveal the true potential of modern technology. Railroads were a dominant force in business and drew heavy capital investments. Railroad stocks soared in the 1830s just as network stocks soared in the 1990s. Railroad stocks were the speculative mania throughout the latter half of the nineteenth century.[15] People, goods, and military forces could be transported as never before, and it seemed that the railroads were changing all aspects of society. Information transmitted by the telegraph greatly influenced how free markets operated, and the way command and control evolved in warfare.

The steam age and railroads had a profound effect on business and the economy. The steam age spawned the efficiencies of the factory and the assembly line and railways created mass markets.[16] Nevertheless, numerous railroads failed, and investments in these companies evaporated, as they have recently in the IT companies of today. By the end of the nineteenth century, the vast majority of these companies failed completely with bankruptcies totaling over three billion in losses.[17] Although this mania was astonishing even in inflation-adjusted terms to today’s value of the dollar, it pales in comparison to the multi-trillion dollar loss of the information age technology mania. The failure was solely due to over investment and the hype that had arisen from unrealistic expectations.

Von Moltke Sr. and the German General Staff used railroads in the deployment of forces with innovative skill. Nevertheless, the military advantage the German General Staff enjoyed from the invention was derived from operational planning necessitated by the technology, not the technology in itself. As with all innovations, the impact decreases in significance when the application of the innovation becomes commonplace.

As the impetus of NCW is not new, the goal to achieve information superiority and shared battle space awareness was not born from the information age of networks. The attempt to achieve a military advantage through shared battle space awareness and IT has evolved into the term NCW.

The U.S. military has pursued shared battle space awareness through technology before the term "NCW" was ever coined. The attempt to achieve shared battle space awareness between sensors and shooter ranges from the use of hot air balloons in the Civil War to modern systems such as Joint Maritime Command Information System, Airborne Warning and Control Systems, or Joint Tactical Information Distribution System. NCW is part of the evolution of an attempt to describe a "system of systems" that achieves shared battle space awareness.

The concept of NCW can be further evaluated from historical examples. A great military leader is the best example to demonstrate that war is an art that cannot be resolved through information superiority on a computer screen or the ability to send thousands of e-mails. In 1863, General Lee defeated General Hooker at Chancellorsville. Although General Hooker had the advantage of battle space awareness, his advantage was soon lost by the friction of war.[18] The advantage of numerical and information superiority was overcome by weather, human error, and lost information.[19]

Innovations in warfare are also stymied by the inability of forces to appropriately adapt the technology into a doctrine or tactic so that it can be effectively utilized. The late 19th century provides several examples where the technology provided no advantage.[20] Bullets could be fired at longer ranges with greater accuracy during the Civil War due to rifled barrels on the new muskets. Yet soldiers failed to use the innovation, and charged the enemy in large groups to fire at close range, since doctrine and training failed to keep pace with technology.[21] Similarly, in 1870 a well trained French Army suffered tremendous battlefield losses from the Germans despite superior rifles and innovative machine guns.[22] The Germans used leadership, doctrine, and unsurpassed operational acumen to easily defeat forces with superior technology. Without the benefit of examining history, France would experience a similar indignation seventy years later from the Germans, this

time with their superior tanks instead of superior rifles. Military technological advancement has always exceeded the required doctrine to effectively utilize the innovation.[23]

THE CORE ASSUMPTIONS

The foundation of NCW is based on three major assumptions. The first is that technology is all-powerful and can overcome all obstacles to shared awareness in both joint and multi-national operations. The second is that self-synchronization can be achieved by rational players through doctrine, training, and clear commander's intent. Finally, once these conditions are met, the third assumption is that there is an enormous inherent power derived from the network itself.

Assuming that technology will overcome all obstacles to the networking of perfect information, human decision-makers will utilize this shared awareness to achieve self-synchronization. Unfortunately, it is possible that technology will not be able solve many issues that have been raised about this concept. How will coalitions participate and achieve shared awareness? If this perfect (timely, accurate, and relevant) information can be obtained, what additional assets will be required to protect it from an asymmetric attack? These concerns are recognized by the NCW pioneers, but are not answered.[24]

> *"Imbalances are growing within the Alliance, between those countries that are investing more quickly in new technologies and capabilities, and those that are proceeding at a slower pace. This is increasingly posing challenges to interoperability, as some Allies move to higher-tech command, control, communication and intelligence equipment…So we need to ensure that we take advantage of technology to enhance our teamwork, rather than letting technology get between us."*[25] *-NATO Secretary General*

The possible cost efficiencies derived from NCW are based on a joint force, but not necessarily on a multinational force. "Almost every time military forces have deployed from the United States it has been as a member-most often to lead-coalition operations."[26] The United States will continue to operate within coalitions in future warfare. This makes access and the cost of equipping all possible coalition partners, or even our long-standing allies with a NCW capability, prohibitive. Unity of command, or unity of effort between multi-national forces that are not part of the network, will be extremely difficult. The enemy as well as our allies will be "locked out." This issue should be answered to understand the realistic cost efficiency of a smaller networked force with degraded coalition capability.

Security and reliability of the network will be central to force capability in the NCW force. As technology proliferates throughout the global community, the ability to conduct asymmetric attacks on the network increases. The potential reward of such an asymmetric Computer Network Attack (CNA) would

make it the most logical main effort of an inferior force. The number of nodes to the network, and the amount of access each player has to it, increases the vulnerability exponentially. The speed and content of information on the network could be susceptible to attack from the enemy, human error resulting from misinterpretation of information, or any possible sensor grid degradations. The goal of perfect information that is continuously secure, relevant, timely, and accurate will always be illusive.

A term from NCW that is relatively new to warfare is self-synchronization. Self-synchronization is central to the concept of NCW that makes it a possible RMA. This human-interaction process is enabled by technological innovation. Self-synchronization is created from a decentralized organizational structure that brings efficiencies to an effort and facilitates the desired result, whether profits to business, or lethality to war. As technology increases the speed of war, self-synchronization is fundamental to the proposed revolution. Nevertheless, it relies on basic human reactions to process and utilize information.

Human frailties prevent perfectly rational behavior in the violent endeavor of war, conducted now at a faster rate in a more complex environment. Thorough training with the most highly capable military personnel only minimizes the potential failure of self-synchronization in war. Additionally, the clearest commander's intent within a decentralized command structure is less than fully satisfying to the question of human limitations and the complex actions required to achieve the mission through self-synchronization. Clausewitz's concept of friction, emotion, and violence are what differentiate war from any other endeavor.

Self-synchronization through clearly articulated commander's intent may well be subverted due to the connectivity of the network. Historically, commander's intent was used to express the mission and derived its importance from the lack of connectivity between significant decision-makers. The inability of commanders at geographically distant locations to personally lead larger armies and fleets is what necessitated delegation to subordinate commanders through commander's intent.[27] If NCW provides fast and reliable connectivity, commander's intent will serve a completely different purpose than to guide the subordinate commander's decision in the absence of his superior's direction. The operational objectives may be stated within the context of the mission, yet commander's intent could be replaced with real-time micro-management, which is very different from the efficiencies derived from the decentralized execution model offered.

Metcalfe's law, which is used to argue the inherent power of the network, may be the weakest assumption for the NCW case. Metcalfe's law states that although the cost to add nodes to the network increases linearly, the value-added increases by the square.[28] This value added by Network Centric operations is the

power that allows us to move away from a platform-centric force. Shooters that are connected to the network no longer need organic sensor capability, thus reducing the cost of that particular node while raising the total effectiveness of the networked force. Yet, the measure of the value added by that particular node and its capability is highly questionable.

Many factors raise the question of the exponential value or any measure of efficiency from Network Centric operations, especially in warfare. The synergistic value added will be greater than the sum of the intrinsic value of each node, but whether it is the square of the nodes, or whether it can be quantified in any mathematical function is difficult in supporting a hypothesis relating to warfare. The quality of interactions between sensor, shooter, and decision-maker creates a highly variable result of the efficiency of the warfare network. Moreover, the varying nature between a shooter-sensor and a shooter-decision maker will largely determine the measure of value to an operational objective. There are innumerable variables to calculate the inherent power of the network when used in warfare.

There is undoubtedly a value creation process through networking. However, if it can be demonstrated that the above cautions are unfounded, the exponential power of Metcalfe's Law creates a different danger to warfare. This highly efficient form of warfare implies a smaller force for a given threat or objective. Subsequently, fewer assets need be allocated per operation. This increases the importance of each node to the success of any mission. The same exponential value created from each node must at the same time be looked at as having significant degradation potential to that force from the loss of a single node. This causes force protection to be even more vital to attaining any operational objective. If the preservation of each node becomes vital, any additional assets or resources necessitated to achieve this required protection further diminish the synergistic value created. Additionally, the technology itself will require new assets and roles in the military to be allocated to maintain the high-tech advantage.[29] The challenges that these assumptions indicate are eerily illustrated in recent military operations.

AMERICAN WAY OF WAR: COUNTER ARGUMENT-KOSOVO

"The air war over Serbia showed that the Air Force has embraced the RMA—not only in its acquisition strategies for emerging technologies, but in the way it used those technologies during this conflict. . . . The United States Air Force . . . showed that it is a leader in the revolution in military affairs by leveraging new concepts to support future joint and coalition efforts. . . . The air war over Serbia offered airmen a glimpse of the future, one in which political leaders turned quickly to the choice of aerospace power to secure the [NATO] Alliance's security interests without resorting to more costly and hazardous alternatives that would have exposed more men and materiel to the ravages of war."[30] -Air Force report on *OAF*

There were numerous technological successes during Allied Force--video teleconferencing, surveillance capabilities with Unmanned Aerial Vehicles (UAV), speed of command, and reach back connectivity with intelligence assets in CONUS. Furthermore, a complex operation was conducted with no NATO combat related casualties.[31] IT enabled a more efficient and effective form of warfare. Yet, the declared RMA in the air war over Serbia is not without troubling aspects of the use of IT and reveals potential dangers that exist in the unrealistic vision of NCW.

The NCW vision fits nicely with the American way of war. NCW proposes efficiency to warfare from IT, as businesses have supposedly reaped productivity gains from the same technology. Network Centric proponents advocate that perfect information utilized through a decentralized and self-synchronous command structure will rapidly achieve operational objectives. Under the umbrella of clear commander's intent, a bottom-up execution will achieve operational objectives at astonishing speed. Paradoxically, during 1999, as the NCW-based technology mania was rampant in the private sector, this vision was disproved on many counts in the military sector.

Although near complete information superiority was achieved early and easily in *OAF*, NATO failed to exploit the information superiority, due to human limitations and low-tech ingenuity by Serbian armed forces. The enemy was able to overcome a great technological disparity by confusing our ability to interpret large amounts of information correctly.[32] The enemy used HUMINT, deception, camouflage, disinformation, and analysis of NATO intelligence operations to overcome our "digital dominance."[33]

Allied Force may provide the best example of the danger of the NCW concept in a prototypical American immaculate war. This example will illustrate a few of the previously described consequences of the pursuit of NCW, and expose corollary derivatives of the major criticisms. The attempt of Allied Force to compel the enemy to do NATO's will without any commitment of ground forces is testament to the confidence in technology. High-tech targeting replaced operational art. The campaign plan was the development of a carefully selected target list with gradual increasing force. General Clark, as SACEUR, would even acknowledge that every principle of war was violated in the beginning of operations.[34] Precision strikes from the air, that were to shock the enemy to capitulation in three days, fell under the weight of the reality of warfare.

DECENTRALIZED OR MICRO-MANAGEMENT MADE EASY?

As previously described as a questionable assumption, NCW relies upon the ability of a force to self-synchronize with perfectly rational players. But even more basic to this concept is the necessary

decentralized C2 structure, which then allows the perfectly rational players to self-synchronize. Although a decentralized structure seems realistic, the same technology that provides information to all levels of command, causes natural human tendencies of ego and military culture to challenge any form of decentralization. The commander may be forced to micro-manage his subordinates on the tactical level, as "future knowledge empowered commanders are likely to find it ethically unacceptable to absolve themselves of accountability for lower-level actions of which they have full knowledge and control, and for which they are ultimately responsible." [35]

There were several examples of dangerous interference by commanders in low-level decisions. General Clark was known to personally redirect UAVs to facilitate surveillance and targeting.[36] There is something fundamentally incorrect when a commander at this level begins to control assets at the lowest tactical level. The real-time information enabled from the UAV and shared at the highest level of command was invaluable, and a testament to information age technology. However, the four-star utilization of the technology reveals a real danger, and the fallacy of "bottom-up empowerment" through technology without enormous changes in doctrine, leadership, and military culture.

Interestingly, the Supreme Allied Commander complained of technology and the micro-management it enabled, “when political leaders can receive updates in real-time, they can take a more active role in directing the pace and conduct of military engagements.”[37] The operational plan was the selection of targets to be destroyed in a sterile way. Sensitive targets were approved by allied capitals, less sensitive were delegated to top NATO commanders, as noted by the Secretary of Defense, in an attempt to rationalize the centralized execution of the war.[38] These examples are not the decentralized, self-synchronization enabled by technology, as some have offered.

FOG OF WAR

It is believed that the network will be able to dissipate the fog of war, but the amount and velocity of information may in fact add new dimensions and layers to the fog. Several historical examples were examined by Rand to reveal that, “a massive flood of real-time information during a battle is unlikely to significantly alter the outcome of the battle; i.e., there are steep decreasing marginal returns to information.”[39] This was never truer than in the case of Allied Force. The enormity of information derived through the technology of satellites and unmanned aircraft created a fast moving battle space picture. The rapid flow of information during Allied Force made situational clarity difficult and effectiveness of engagements hard to determine. Admiral Ellis, Commander in Chief of NATO’s Allied Forces Southern

Europe, remarked on the information overload in Allied Force as: "Information saturation is additive to the fog of war…" [40] Secretary of Defense William Cohen added that the vast amount of information in itself skewed the battle space awareness, due to human limitations in processing the information.[41]

The application of this Video Teleconference (VTC) technology is continuing to evolve into an incredible enabling tool. Many levels of command are able to view simultaneously the commander's intent. SIPRNET allows formal directives to be issued far faster than the traditional message delivery system. Yet, this technology outpaced the required organizational changes, procedures, and doctrine for its effective application.

The new means that technology affords in planning can be extremely efficient, but was a duplicating and time-consuming effort in Kosovo. VTCs were used widely on a daily basis during *OAF*. Video teleconferencing seemed to be an invaluable tool in the planning process and for routine coordination. However, Admiral Ellis noted that the VTC technology was a time-consuming planning tool, which actually lengthened the decision cycle times.[42] Additionally, the authority of these VTCs was unclear. The absence of any written documentation was troublesome for those who had to take actions based on what was perceived to be the commander's desire.[43] This same issue of formal direction process has occurred with e-mail. The ability to communicate quickly with e-mail loses all efficiency when such discussions have to be referenced in formal message formats to ensure a traditional authoritative process.

COALITION INTEROPERABILITY

As interoperability between our allies has been questioned for a Network Centric force, there were even more basic divisions of technological disparity. During Allied Force, secure voice communications were unavailable among NATO members, and this resulted in sensitive information being intercepted by the enemy.[44] This basic communication capability is far from the connection to a common network. Moreover, this interoperability problem existed between longstanding allies in NATO, not newly formed coalition partners.

The dissemination of information divided unity of command even when communication paths were established. Dissemination of vital SIGINT and IMINT was severely restricted to NATO members simply due to the classification.[45] The benefit to a combined networked force will surely be challenged if some aspects of battle space awareness are not shared. These examples harbinger the growing isolationism in unity of command and unity of effort, which our forces could experience as they connect to the network and the disparity of technological capabilities widens with our allies.

CONCLUSION

Innovations in warfare have previously created outrageous claims by proponents of their development, as was the case for the airplane. Moreover, there have been those who have criticized the innovation in order to protect their own self-interest. Innovation and cultural change are able to find many opponents among military leaders. The truth usually lies somewhere between these views. This analysis does not attempt a total invalidation of the NCW concept, but offers numerous criticisms to counter the exaggerated and unsubstantiated claims that NCW proponents have hypothesized. IT is having a profound effect on warfare; well thought out applications of this technology from realistic expectations is what is needed. A realistic approach to networks in fighting wars is required, not the unfounded hype of RMAs. Military culture, and the nature of the military professional, will ultimately shape the future of NCW, not the technology itself.

In an attempt to answer the question of what is the realistic application of IT to warfare on the basis of known technological capabilities, this analysis started where the advocates began the argument for the NCW revolution, in the private sector. A critical look at the private sector revealed an underlying hype of IT's effect on business and the economy. Moreover, history is littered with examples of a new technology, from railroads to the airplane, that give rise to similar exaggerations in impact on all aspects of society, including warfare.

Understanding the phenomena that have given rise to information-age hype and a possible RMA, an informed review of the elemental concepts of NCW uncovers some basic flaws in the theory. The concept is indeed not about the technology; it is about how humans respond to information as a tool, whether in business or warfare. Human limitations, including emotions and sometimes irrational behavior, will always be the deciding factor, no matter how advanced the tools that are utilized. NCW relies on assumptions that have been demonstrated to be inaccurate in the private sector, and are even more doubtful in the uniquely chaotic endeavor that is warfare. Military operations such as *OAF* demonstrate that IT and information operations will play a major role in future military conflicts, and significant challenges to this evolution from incredible technological advances will have to be addressed. The impact of the information age on warfare should be viewed as a necessary evolution, not necessarily a revolution.

RECOMMENDATIONS/TAKE AWAYS

-Decisions that will be made to shape the future force should be made within a framework of realistic expectations, to ensure we maintain a credible force that is still based on the fundamental principles and lessons learned, not unfounded hype or assumptions.

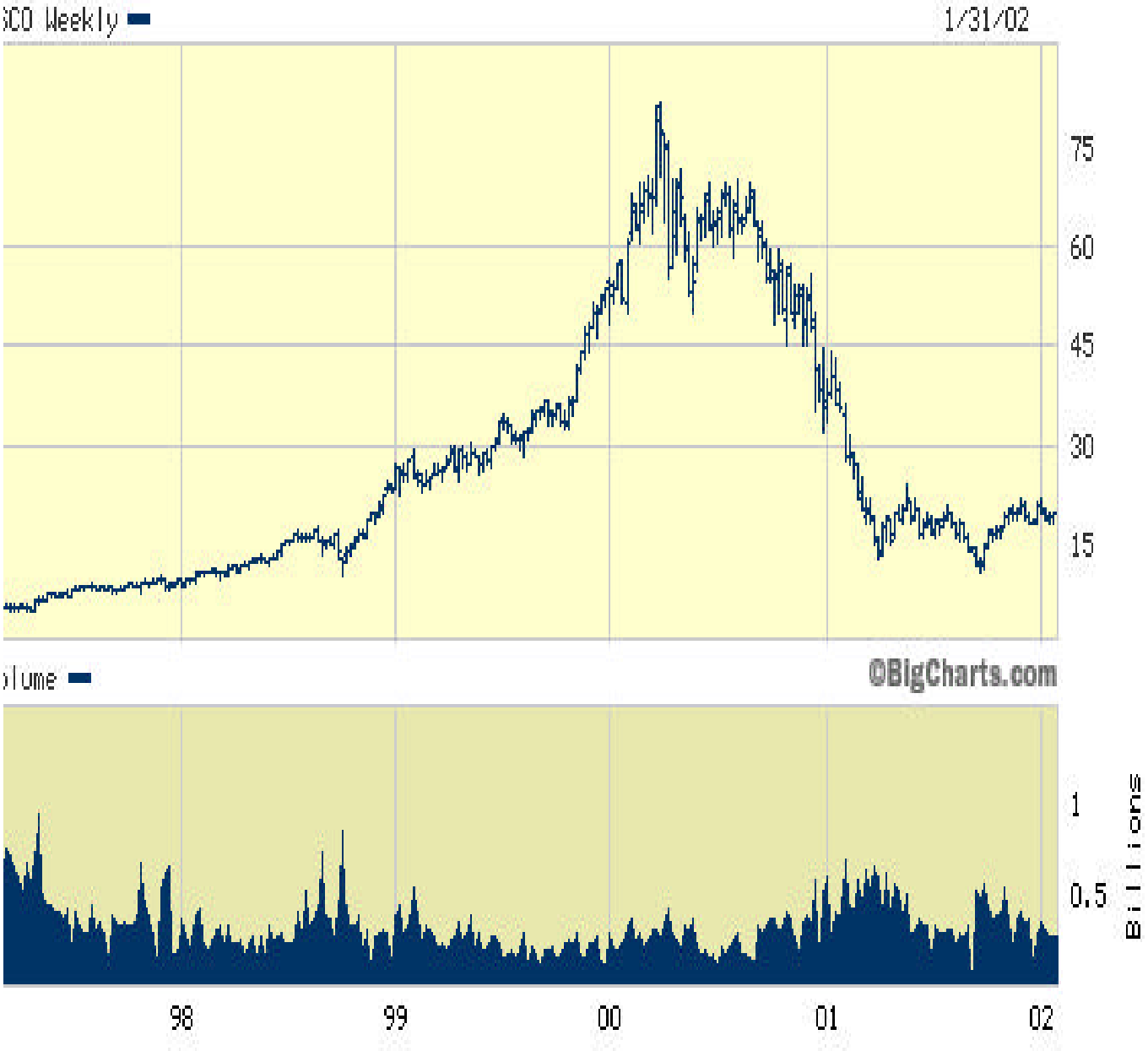
-IT may increase the efficiency of a force, but exaggerations in capability may lead to a smaller and less capable force, especially in the context of coalition warfare.

-Military culture and doctrine should evolve as quickly as technology for its effective application. No one technology, regardless of advanced targeting capability, will ever replace military leadership, operational art, or the principles of war.

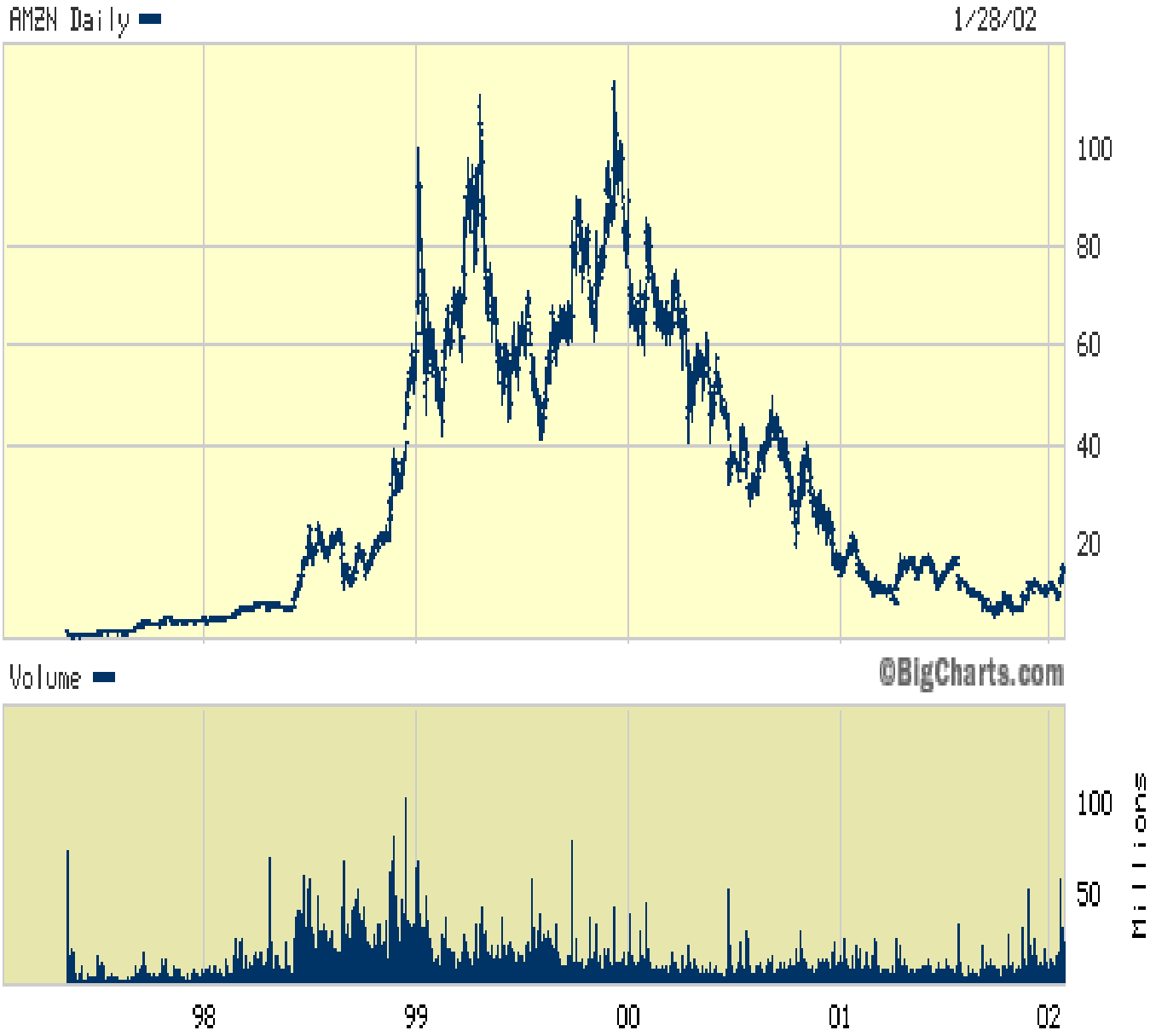
Appendix A

All Charts are courtesy of Charles Schwab &Co. The charts are linear and are on a five-year time frame. The dates of the chart are posted in the upper-right hand corner. The price and volume charts clearly depict the mania that information technology companies experienced in a matter of a few years (1999-2000). Charts may be verified at <http://www.schwab.com>

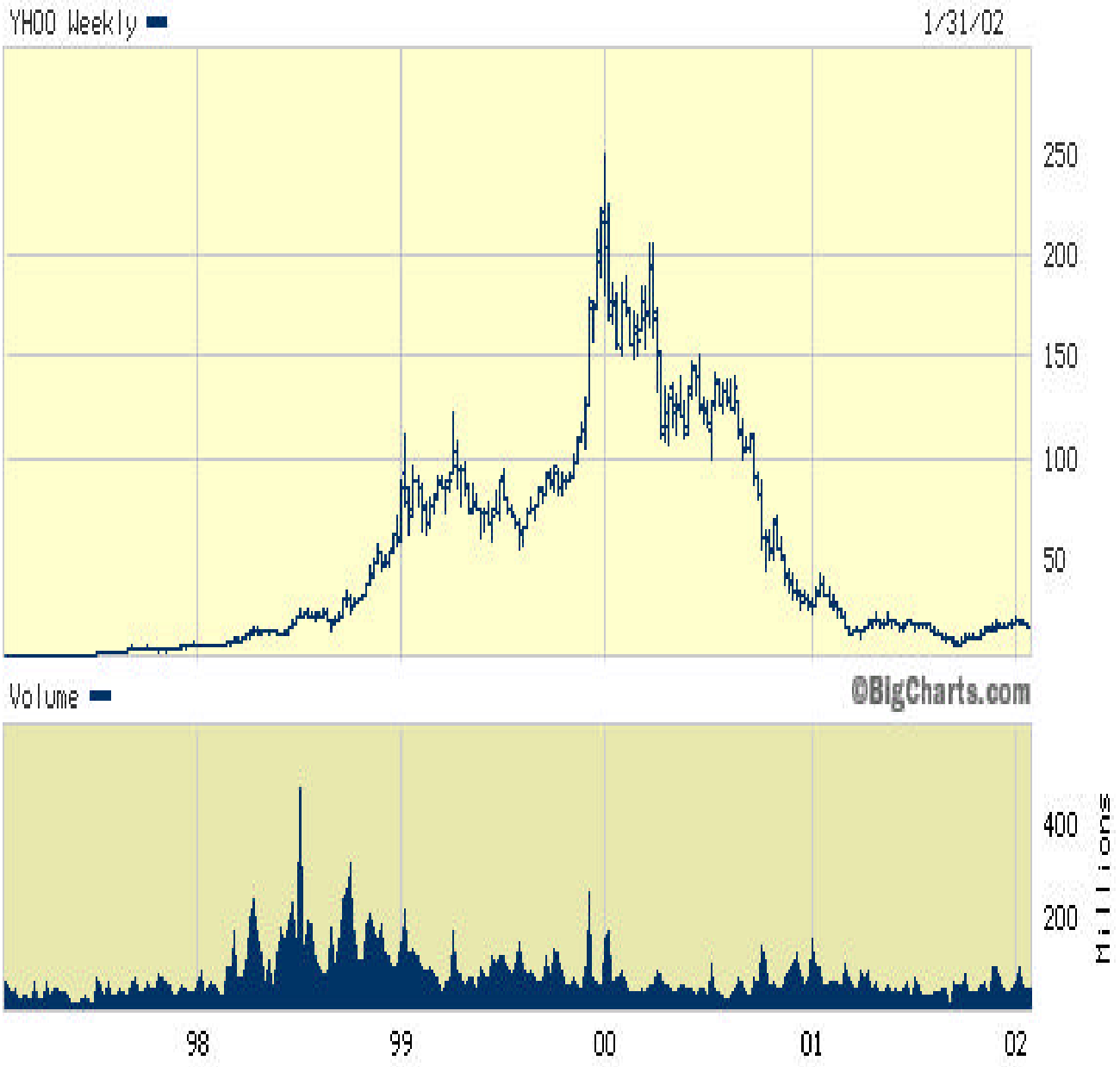
Cisco Systems (fig.1)



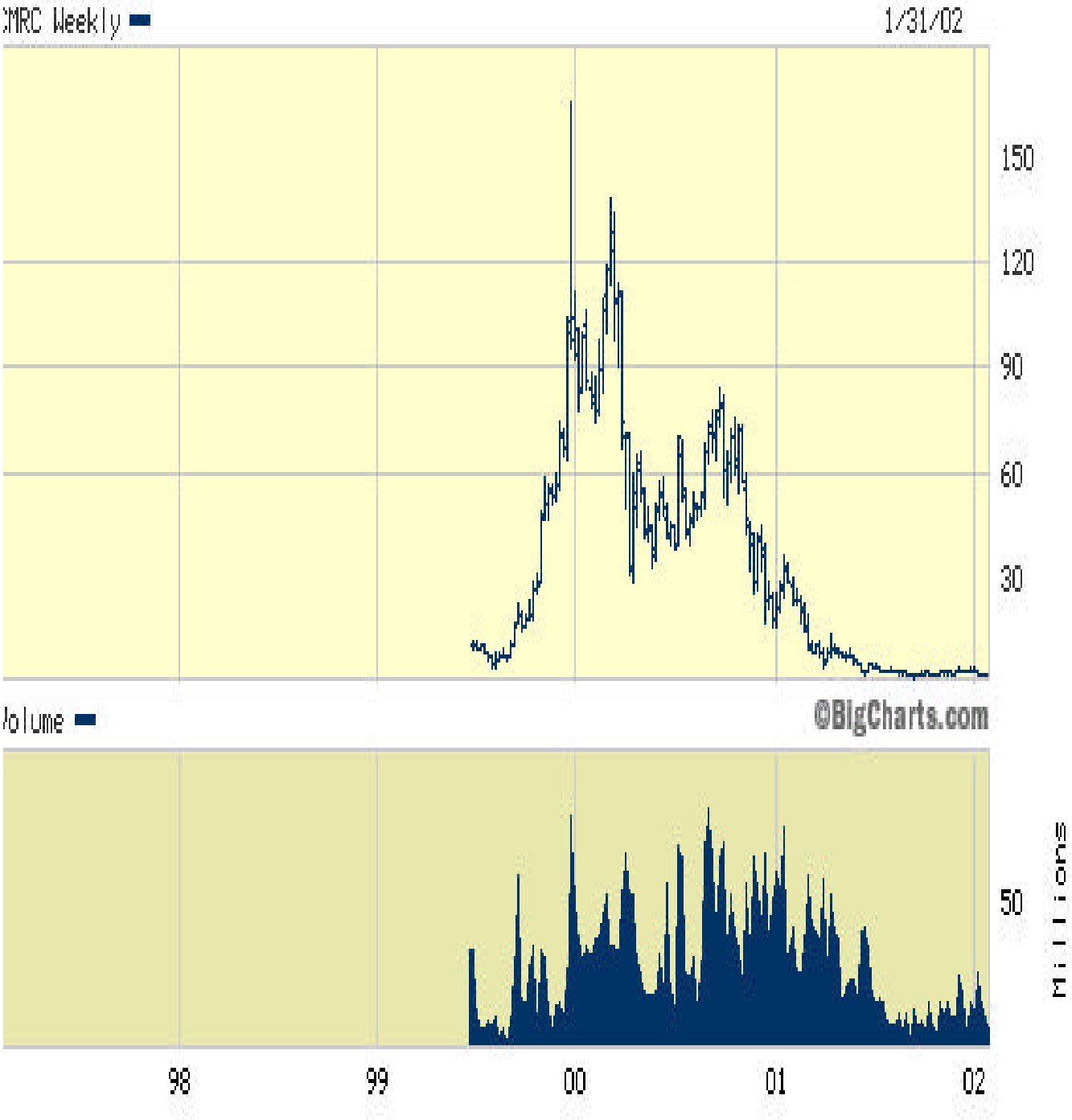
Amazon.com (fig.2)


AMZN Daily
1/28/02
100
80
60
40
20
Volume
©BigCharts.com
100
50
Millions
98
99
00
01
02

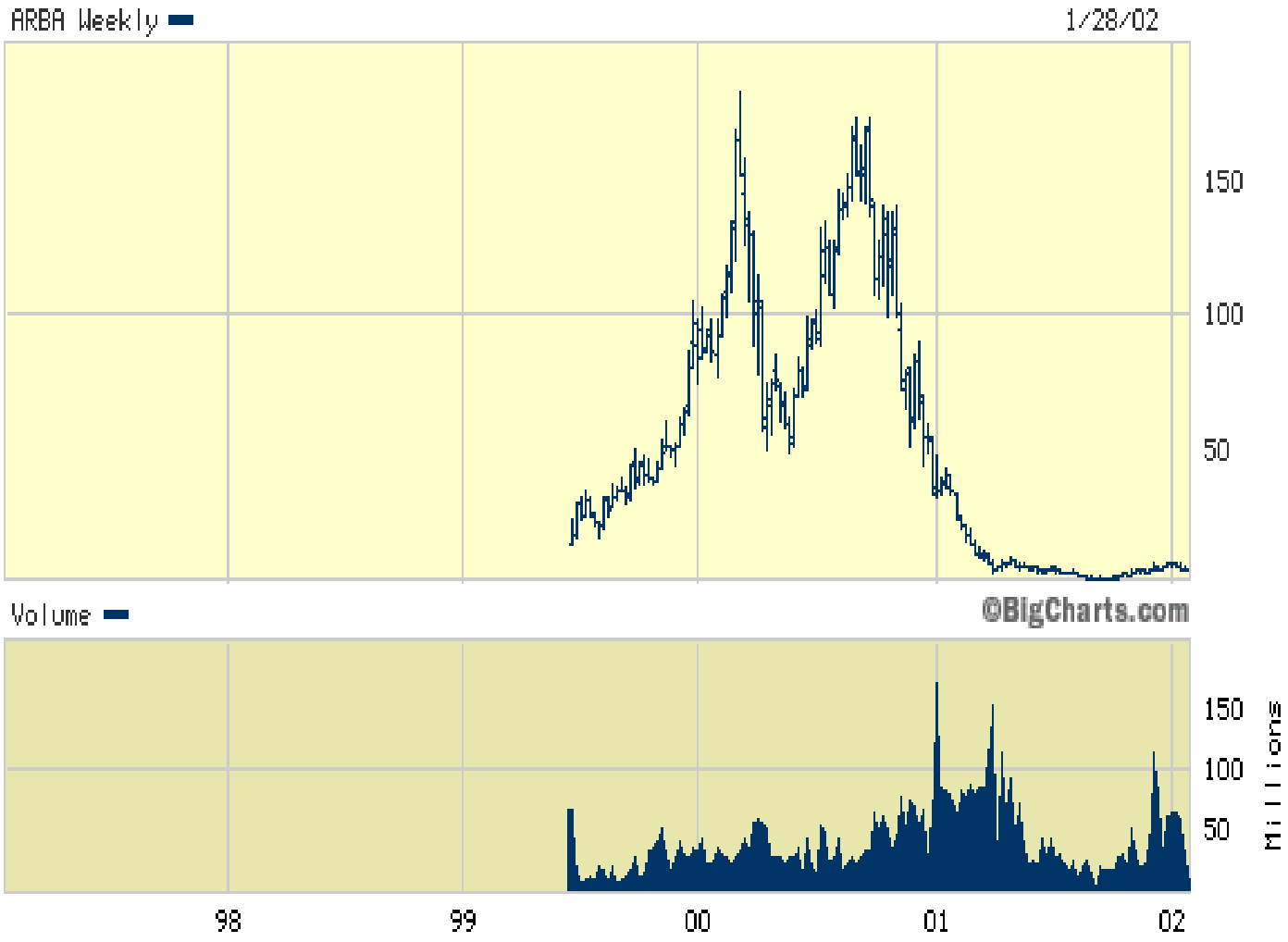
Yahoo (fig.3)



Commerce One (fig.4)


CMRC Weekly
1/31/02
150
120
90
60
30
Volume
©BigCharts.com
50
Millions
98
99
00
01
02

Ariba (fig.5)


ARBA Weekly
1/28/02
150
100
50
Volume
©BigCharts.com
150
100
50
Millions
98
99
00
01
02

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